

- 1 1. A method of producing an oriented oxide superconducting film, comprising:
  - 2 (a) providing a metal oxyfluoride film on a substrate, said metal oxyfluoride film
  - 3 comprising the constituent metallic elements of an oxide superconductor
  - 4 in substantially stoichiometric proportions;
  - 5 (b) initiating conversion of the metal oxyfluoride into the oxide superconductor in
  - 6 a processing gas having a moisture content of less than 1% by mass and a
  - 7 total pressure less than atmospheric pressure for a time sufficient to form a
  - 8 layer of the oxide superconductor at the substrate/film interface; and
  - 9 (c) completing conversion of the metal oxyfluoride into the oxide superconductor
  - 10 in a processing gas having a moisture content greater than that in step (b)
  - 11 and a total pressure less than atmospheric pressure.
- 12 2. The method of claim 1, wherein the moisture content in step (c) is between 4.5
- 13 and 35% by mass.
- 14 3. The method of claim 1, wherein the  $\text{PH}_2\text{O}$  during step (b) is less than 10 mTorr
- 15 and the total pressure is about 8 Torr or less.
- 16 4. The method of claim 1, wherein the  $\text{PH}_2\text{O}$  during step (c) is between 150 and 350
- 17 mTorr and the total pressure is about 8 Torr or less
- 18 5. The method of claim 1, wherein the total pressure is less than about 8 Torr.
- 19 6. The method of claim 5, wherein the total pressure is less than about 1 Torr.
- 20 7. The method of claim 1, wherein the total pressure is less than about 0.1 Torr.
- 21 8. The method of claim 1, wherein the processing gas consists substantially of water
- 22 vapor and oxygen.
- 23 9. The method of claim 1, further comprising depositing a buffer layer on the
- 24 substrate before the step of depositing.

- 1 10. The method of claim 9, wherein the buffer layer comprises a member of yttria-  
2 stabilized zirconia,  $\text{LaAlO}_3$ ,  $\text{SrTiO}_3$ ,  $\text{CeO}_2$ ,  $\text{Y}_2\text{O}_3$ , and  $\text{MgO}$  and any combination  
3 of the above.
- 4 11. The method of claim 1, wherein the film has a thickness of at least  $0.3\mu\text{m}$ .
- 5 12. The method of claim 11, wherein the film has a thickness of at least  $0.5\mu\text{m}$ .
- 6 13. The method of claim 12, wherein the film has a thickness of at least  $0.8\mu\text{m}$ .
- 7 14. The method of claim 13, wherein the film has a thickness of at least  $1\mu\text{m}$ .
- 8 15. The method of claim 1, wherein the superconductor comprises YBCO.
- 9 16. The method of claim 1, wherein the substrate comprises a ceramic.
- 10 17. The method of claim 16, wherein the ceramic is selected from the group  
11 consisting of YSZ,  $\text{LaAlO}_3$ ,  $\text{SrTiO}_3$ ,  $\text{CeO}_2$ , and  $\text{MgO}$ .
- 12 18. The method of claim 1, wherein the substrate comprises a metal having a texture  
13 selected from untextured, uniaxial texturing, and biaxial texturing.
- 14 19. The method of claim 18, wherein the metal is selected from steel, nickel, iron,  
15 molybdenum, copper, silver, and alloys and mixtures thereof.
- 16 20. A c-axis textured superconducting film fabricated by the steps of  
17 (a) providing a metal oxyfluoride film on a substrate, said metal oxyfluoride film  
18 comprising the constituent metallic elements of an oxide superconductor  
19 in substantially stoichiometric proportions;  
20 (b) initiating conversion of the metal oxyfluoride into the oxide superconductor in  
21 a processing gas having a moisture content of less than 5% by mass and a  
22 total pressure less than atmospheric pressure for a time sufficient to form a  
23 layer of the oxide superconductor at the substrate/film interface; and

- 1 (c) completing conversion of the metal oxyfluoride into the oxide superconductor  
2 in a processing gas having a moisture content greater than that in step (b)  
3 and a total pressure less than atmospheric pressure.
- 4 21. The c-axis textured superconducting film of claim 20, wherein the texture is  
5 biaxial.
- 6 22. The c-axis textured superconducting film of claim 20, wherein the film has a  $J_c$   
7 greater than  $0.45 \text{ MA/cm}^2$ .
- 8 23. The c-axis textured superconducting film of claim 22, wherein the film has a  $J_c$   
9 greater than  $1 \text{ MA/cm}^2$ .
- 10 24. The c-axis textured superconducting film of claim 23, wherein the film has a  $J_c$   
11 greater than  $2 \text{ MA/cm}^2$ .
- 12 25. The c-axis textured superconducting film of claim 24, wherein the film has a  $J_c$   
13 greater than  $4 \text{ MA/cm}^2$ .
- 14 26. The c-axis textured superconducting film of claim 20, wherein the moisture  
15 content in step (c) is between 4.5 and 34%.
- 16 27. The c-axis textured superconducting film of claim 20, wherein the  $\text{PH}_2\text{O}$  during  
17 step (b) is less than 10 mTorr and the total pressure is about 8 Torr or less.
- 18 28. The c-axis textured superconducting film of claim 20, wherein the  $\text{PH}_2\text{O}$  during  
19 step (c) is between 150 and 350 mTorr and the total pressure is about 8 Torr or  
20 less.
- 21 29. The c-axis textured superconducting film of claim 20, wherein the total pressure  
22 is less than about 8 Torr.
- 23 30. The c-axis textured superconducting film of claim 20, wherein the processing gas  
24 consists substantially of water vapor and oxygen.

- 1     31.     The c-axis textured superconducting film of claim 20, wherein the substrate  
2               comprises a base and a buffer layer interposed between the base and the  
3               superconducting film.
- 4     32.     The c-axis textured superconducting film of claim 31, wherein the buffer layer  
5               comprises a member of ceria, yttria-stabilized zirconia, yttrium oxide, and any  
6               combination of the above.
- 7     33.     The c-axis textured superconducting film of claim 20, wherein the film has a  
8               thickness of at least 0.5 $\mu$ m.
- 9     34.     The c-axis textured superconducting film of claim 33, wherein the film has a  
10              thickness of at least 1  $\mu$ m.
- 11    35.     The c-axis textured superconducting film of claim 20, wherein the superconductor  
12              comprises YBCO.
- 13    36.     The c-axis textured superconducting film of claim 20, wherein the substrate  
14              comprises a ceramic.
- 15    37.     The c-axis textured superconducting film of claim 36, wherein the ceramic is  
16              selected from the group consisting of YSZ, LaAlO<sub>3</sub>, SrTiO<sub>3</sub>, CeO<sub>2</sub>, and MgO.
- 17    38.     The c-axis textured superconducting film of claim 20, wherein the substrate  
18              comprises a metal.
- 19    39.     The c-axis textured superconducting film of claim 38, wherein the metal is  
20              selected from steel, nickel, iron, molybdenum, copper, silver, and alloys and  
21              mixtures thereof.
- 22    40.     A method of producing an oriented oxide superconducting film, comprising:  
23              (a) providing a metal oxyfluoride film on a substrate, said metal oxyfluoride film  
24                      comprising the constituent metallic elements of an oxide superconductor  
25                      in substantially stoichiometric proportions;

- 1 (b) converting the metal oxyfluoride into the oxide superconductor in a processing  
2 gas having a total pressure less than atmospheric pressure.
- 3 41. The method of claim 40, wherein the total pressure is less than about 8 Torr.
- 4 42. The method of claim 41, wherein the total pressure is less than about 1 Torr.
- 5 43. The method of claim 42, wherein the total pressure is less than about 0.1 Torr.
- 6 44. The method of claim 43, wherein the total pressure is less than about 0.01 Torr.
- 7 45. The method of claim 44, wherein the total pressure is less than about 0.01 Torr.
- 8 46. The method of claim 45, wherein the total pressure is less than about 0.001 Torr.
- 9 47. The method of claim 40, wherein the processing gas consists substantially of  
10 water vapor and oxygen.
- 11 48. The method of claim 40, further comprising depositing a buffer layer on the  
12 substrate before the step of depositing.
- 13 49. The method of claim 48, wherein the buffer layer comprises a member of yttria-  
14 stabilized zirconia,  $\text{LaAlO}_3$ ,  $\text{SrTiO}_3$ ,  $\text{CeO}_2$ ,  $\text{Y}_2\text{O}_3$ , and  $\text{MgO}$  and any combination  
15 of the above.
- 16 50. The method of claim 40, wherein the film has a thickness of at least  $0.3\mu\text{m}$ .
- 17 51. The method of claim 50, wherein the film has a thickness of at least  $0.5\mu\text{m}$ .
- 18 52. The method of claim 51, wherein the film has a thickness of at least  $0.8\mu\text{m}$ .
- 19 53. The method of claim 52, wherein the film has a thickness of at least  $1\mu\text{m}$ .
- 20 54. The method of claim 40, wherein the superconductor comprises YBCO.
- 21 55. The method of claim 40, wherein the substrate comprises a ceramic.

- 1    56.    The method of claim 55, wherein the ceramic is selected from the group  
2           consisting of YSZ, LaAlO<sub>3</sub>, SrTiO<sub>3</sub>, CeO<sub>2</sub>, and MgO.
- 3    57.    The method of claim 40, wherein the substrate comprises a metal having a texture  
4           selected from untextured, uniaxial texturing, and biaxial texturing.
- 5    58.    The method of claim 57, wherein the metal is selected from steel, nickel, iron,  
6           molybdenum, copper, silver, and alloys and mixtures thereof.
- 7    59.    The method of claim 40, wherein the film has a J<sub>c</sub> greater than 0.45 MA/cm<sup>2</sup>.
- 8    60.    The method of claim 59, wherein the film has a J<sub>c</sub> greater than 1 MA/cm<sup>2</sup>.
- 9    61.    The method of claim 60, wherein the film has a J<sub>c</sub> greater than 2 MA/cm<sup>2</sup>.
- 10   62.    The method of claim 61, wherein the film has a J<sub>c</sub> greater than 4 MA/cm<sup>2</sup>.